

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
17 March 2005 (17.03.2005)

PCT

(10) International Publication Number
WO 2005/023542 A1

(51) International Patent Classification⁷: **B32B 27/34**,
F16L 11/04, 9/12

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(21) International Application Number:
PCT/EP2004/010059

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(22) International Filing Date:
9 September 2004 (09.09.2004)

(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
103 41 988.8 9 September 2003 (09.09.2003) DE

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI,
SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

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Published:

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

(54) Title: MULTI-LAYER FUEL- AND VAPOR TUBE COMPRISING POLYPHTHALAMIDE

(57) Abstract: The invention is concerned with multilayer tubes for use in a vehicle, containing at least one Polyphthalamide-layer, which can be used as fuel or vapor tube in a vehicle.



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Title: Multi-layer fuel- and vapor tube comprising
Polyphthalamide

Description

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The invention is concerned with multilayer tubes for use in a motor-vehicle.

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Large strains (e.g. bending, elongation) are expected against fuel lines and therefore high technical standards are required.

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In the state of the art fuel and vapor tubes consisting of polyamides are described. It is increasingly important, that the used tubes are essentially impermissible against fluid emissions (e.g. hydrocarbons in fuels).

20

Thus a hydrocarbon permission level for such a tube of equal or below 0,5 g/m² for a time frame of 24 h (1 d) is required. Furthermore, it is required, that the used fuel tubes do not have interactions with existing materials within the fuel, like oxidants, detergents, tensides and additives (e.g. ethanol, methanol, etc.)

25

Moreover penetration of fluids may lead to crystallisation of tubing material (e.g. when using Nylon 11, Nylon 12, in particular in presence of copper ions) and blocking of the tube.

30

For those reasons multilayer tubes are of particular interest. However, it is difficult to obtain satisfactory laminate characteristics between dissimilar polymeres, as given in the case of a multilayer tube.

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Particular one object of the invention is to provide a novel barrier layer having stable carrier characteristics in the frame of multilayer tubes.

The object is solved by a multilayer tube having the features of claim 1, in particular a multilayer tube comprising at least one Polyphthalamide layer, being used as fuel- or vapor tube. Further embodiments result from the appropriate sub-claims.

According to the invention the term „tube“ is to be understood as a functional synonym or equivalent corresponding to "hose" or "line".

"Multilayer tube" means a tube consisting of at least two layers. More preferably the tube consists of three and more layers, most preferably 3 - 5 or 6 layers (cf. embodiments in detail below); further layers are also possible.

According to the present invention at least one Polyphthalamide (in short: PPA) layer is a suitable barrier layer of the tube, preferably comprising one or more Polyamide layer.

If necessary in combination with a bonding layer, preferably selected from a polyamide.

Polyamides are preferably selected from the group consisting of 6,6-Polyamide (in short: PA 6), 11,11-Polyamide (in short: PA 11), 12,12-Polyamide (in short: PA 12), Copolymer derived from 6,6-Polyamide and 12,12-Polyamide (in short: PA 6/12).

Layers consisting of Polyethylene (in short: PE) or Polypropylene (in short: PP) or a Copolymer thereof may also contain.

Moreover, PPA layer(s) thinner than other layers, in particular Polyamide layers, are preferred.

In a further preferred embodiment according to the invention the outer layer and/or inner layer consists of PPA. This

depends on the fact, that embodiments having PPA - intermediate layer exhibit less laminate characteristics than those embodiments comprising PPA- inner and / or outer layer.

- 5 A further embodiment relates to a multilayer tube according to the invention, wherein at least one layer, in fact PPA- or PA-layer is conductible.
The conductivity of the tube may be provided for example (non-complete listing) by the means of surcharges of carbon
10 (also carbon black) or metals (Cu, Si, Ag, Au, Ni etc.).

In the following such a conductive layer is denoted as PPA cond. or PA cond..

- 15 The multilayer tubes prove to be stable and strainable, also respectively bending and elongation under maintenance of the laminate characteristics.

- Hence, an especial embodiment concerns a multilayer tubing,
20 comprising at least one PPA-layer and at least one Polyamide, non-completing selected from the group having the layers:

- PPA - PA 6 - PA 6/12 (bonding agent) - PA 12,
PPA - PA 6 - PA 6/12 (bonding agent) - PPA,
25 PPA - PA 6/12 (bonding agent) - PA 12,
PA 6 - PPA - PA 6,
PA 12 - PPA - PA 12,
PPA - PA 6 (bonding agent) - PPA,
PPA cond. - PPA - PA 6 (bonding agent) - PPA.

- 30 (notation from inner layer - outer layer)

Within this group, embodiments having PPA as outer and / or inner layer are preferred.

Most advantageous are the high temperature resistance, chemical inert properties, flexibility of the performance, good adhesion.

- 5 Especially advantageous are the high temperature constancy, chemical inertness, flexibility of tubes, as well as good layer adhesion as well as good permeation constancy.

10 In contrast to pure polyamide tubes a temperature constancy of up to 140° Celsius can be achieved.

The multilayer tubes according to the invention can be used for all types of conventional fuel and petrol or vapors (including gases) and are obtainable in every desired length and thickness (diameter as well as wall thickness).

15

The tube materials mentioned in this context are exclusively materials that can be commercially acquired in trade. The tube materials indicated are all easily extrudable, if necessary co-extrudable and easily accessible to fusion

20

processing as thermoplastic materials. The layers adhere to one another due to permanent laminar adhesion, if necessary supported by means of a bonding agent or an adhesive (e.g. glue as well). All embodiments of the multilayer tubes as per the invention can be manufactured by the person skilled in

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the art in a known manner.

In a further embodiment the layers can contain additions, i.e. the usual softeners, flame restraints and anti-oxidation means or stabilising agents.

30

The multiplayer tubes as per the layer in question can optionally contain an outer cover, which e. g. consists of a adequate thermoplastic suitable for fusion processing, which is either co-extruded or attached, for the purpose of an

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additional isolation (protection). Furthermore, this layer may be able to lead off electrostatic energy. According to

the invention such an outer cover shall be not read as a synonym for outer layer.

Furthermore the invention, and not finally, is concerned
 5 with such conductive and non-conductive layer combinations as follows, wherein the term "BA" designates "Bonding agent" (adhesive) :

Nicht leitfähig / Non conductive

PPA		PE
PPA		PP
PPA		PA 6
PPA		PA 11
PPA		PA 12
PE		PPA
PP		PPA
PA 6		PPA
PA 11		PPA
PA 12		PPA
PPA	BA	PPA
PPA	BA	PE
PPA	BA	PP
PPA	BA	PA 6
PPA	BA	PA 11
PPA	BA	PA 12
PE	BA	PPA
PP	BA	PPA
PA 6	BA	PPA
PA 11	BA	PPA
PA 12	BA	PPA
PPA	PA 6/12	PPA
PPA	PA 6/12	PE
PPA	PA 6/12	PP
PPA	PA 6/12	PA 6
PPA	PA 6/12	PA 11
PPA	PA 6/12	PA 12

6

	PE	PA 6/12	PPA
	PP	PA 6/12	PPA
	PA 6	PA 6/12	PPA
	PA 11	PA 6/12	PPA
	PA 12	PA 6/12	PPA
	PE	PPA	PE
	PP	PPA	PP
	PA 6	PPA	PA 6
	PA 11	PPA	PA 11
	PA 12	PPA	PA 12
	PE	PPA	PP
	PE	PPA	PA 6
	PE	PPA	PA 11
	PE	PPA	PA 12
	PP	PPA	PE
	PA 6	PPA	PE
	PA 11	PPA	PE
	PA 12	PPA	PE
	PP	PPA	PA 6
	PP	PPA	PA 11
	PP	PPA	PA 12
	PA 6	PPA	PP
	PA 11	PPA	PP
	PA 12	PPA	PP
	PA 6	PPA	PA 11
	PA 6	PPA	PA 12
	PA 11	PPA	PA 6
	PA 12	PPA	PA 6
	PA 11	PPA	PA 12
	PA 12	PPA	PA 11
PE	BA	PPA	PE
PP	BA	PPA	PP
PA 6	BA	PPA	PA 6
PA 11	BA	PPA	PA 11
PA 12	BA	PPA	PA 12
PE	PA 6/12	PPA	PE

	PP	PA 6/12	PPA	PP
	PA 6	PA 6/12	PPA	PA 6
	PA 11	PA 6/12	PPA	PA 11
	PA 12	PA 6/12	PPA	PA 12
	PE	PPA	BA	PE
	PP	PPA	BA	PP
	PA 6	PPA	BA	PA 6
	PA 11	PPA	BA	PA 11
	PA 12	PPA	BA	PA 12
	PE	PPA	PA 6/12	PE
	PP	PPA	PA 6/12	PP
	PA 6	PPA	PA 6/12	PA 6
	PA 11	PPA	PA 6/12	PA 11
	PA 12	PPA	PA 6/12	PA 12
	PPA	PE	BA	PPA
	PPA	PE	BA	PE
	PPA	PP	BA	PP
	PPA	PA 6	BA	PA 6
	PPA	PA 11	BA	PA 11
	PPA	PA 12	BA	PA 12
	PPA	PE	PA 6/12	PPA
	PPA	PE	PA 6/12	PE
	PPA	PP	PA 6/12	PP
	PPA	PA 6	PA 6/12	PA 6
	PPA	PA 11	PA 6/12	PA 11
	PPA	PA 12	PA 6/12	PA 12
PPA	BA	PA 6/12	BA	PPA
PPA	BA	PA 6/12	BA	PE
PPA	BA	PA 6/12	BA	PP
PPA	BA	PA 6/12	BA	PA 6
PPA	BA	PA 6/12	BA	PA 11
PPA	BA	PA 6/12	BA	PA 12
PE	BA	PA 6/12	BA	PPA
PP	BA	PA 6/12	BA	PPA
PA 6	BA	PA 6/12	BA	PPA
PA 11	BA	PA 6/12	BA	PPA

PA 12	BA	PA 6/12	BA	PPA
PPA	PA 6	PA 6/12	BA	PPA
PPA	PA 6	PA 6/12	BA	PE
PPA	PA 6	PA 6/12	BA	PP
PPA	PA 6	PA 6/12	BA	PA 6
PPA	PA 6	PA 6/12	BA	PA 11
PPA	PA 6	PA 6/12	BA	PA 12
PPA	PA 11	PA 6/12	BA	PPA
PPA	PA 11	PA 6/12	BA	PE
PPA	PA 11	PA 6/12	BA	PP
PPA	PA 11	PA 6/12	BA	PA 6
PPA	PA 11	PA 6/12	BA	PA 11
PPA	PA 11	PA 6/12	BA	PA 12
PPA	PA 12	PA 6/12	BA	PPA
PPA	PA 12	PA 6/12	BA	PE
PPA	PA 12	PA 6/12	BA	PP
PPA	PA 12	PA 6/12	BA	PA 6
PPA	PA 12	PA 6/12	BA	PA 11
PPA	PA 12	PA 6/12	BA	PA 12
PA 6	PPA	PA 6/12	BA	PE
PA 6	PPA	PA 6/12	BA	PP
PA 6	PPA	PA 6/12	BA	PA 6
PA 6	PPA	PA 6/12	BA	PA 11
PA 6	PPA	PA 6/12	BA	PA 12
PA 11	PPA	PA 6/12	BA	PE
PA 11	PPA	PA 6/12	BA	PP
PA 11	PPA	PA 6/12	BA	PA 6
PA 11	PPA	PA 6/12	BA	PA 11
PA 11	PPA	PA 6/12	BA	PA 12
PA 12	PPA	PA 6/12	BA	PE
PA 12	PPA	PA 6/12	BA	PP
PA 12	PPA	PA 6/12	BA	PA 6
PA 12	PPA	PA 6/12	BA	PA 11
PA 12	PPA	PA 6/12	BA	PA 12
PA 6	PA 6/12	PPA	BA	PE
PA 6	PA 6/12	PPA	BA	PP

PA 6	PA 6/12	PPA	BA	PA 6
PA 6	PA 6/12	PPA	BA	PA 11
PA 6	PA 6/12	PPA	BA	PA 12
PA 11	PA 6/12	PPA	BA	PE
PA 11	PA 6/12	PPA	BA	PP
PA 11	PA 6/12	PPA	BA	PA 6
PA 11	PA 6/12	PPA	BA	PA 11
PA 11	PA 6/12	PPA	BA	PA 12
PA 12	PA 6/12	PPA	BA	PE
PA 12	PA 6/12	PPA	BA	PP
PA 12	PA 6/12	PPA	BA	PA 6
PA 12	PA 6/12	PPA	BA	PA 11
PA 12	PA 6/12	PPA	BA	PA 12
PA 6	PA 6/12	PE	BA	PPA
PA 6	PA 6/12	PP	BA	PPA
PA 6	PA 6/12	PA 6	BA	PPA
PA 6	PA 6/12	PA 11	BA	PPA
PA 6	PA 6/12	PA 12	BA	PPA
PA 11	PA 6/12	PE	BA	PPA
PA 11	PA 6/12	PP	BA	PPA
PA 11	PA 6/12	PA 6	BA	PPA
PA 11	PA 6/12	PA 11	BA	PPA
PA 11	PA 6/12	PA 12	BA	PPA
PA 12	PA 6/12	PE	BA	PPA
PA 12	PA 6/12	PP	BA	PPA
PA 12	PA 6/12	PA 6	BA	PPA
PA 12	PA 6/12	PA 11	BA	PPA
PA 12	PA 6/12	PA 12	BA	PPA

Or:

leitfähig/conductive (cond.)

Von Innen / Inner layer		Nach Außen /	Outer layer
PPA cond			PPA
PPA cond	PPA		PE

10

PPA cond	PPA		PP
PPA cond	PPA		PA 6
PPA cond	PPA		PA 11
PPA cond	PPA		PA 12
PPA cond	PE		PPA
PPA cond	PP		PPA
PPA cond	PA 6		PPA
PPA cond	PA 11		PPA
PA cond	PA 12		PPA
PPA cond	PPA	BA	PPA
PPA cond	PPA	BA	PE
PPA cond	PPA	BA	PP
PPA cond	PPA	BA	PA 6
PPA cond	PPA	BA	PA 11
PPA cond	PPA	BA	PA 12
PPA cond	PE	BA	PPA
PPA cond	PP	BA	PPA
PPA cond	PA 6	BA	PPA
PPA cond	PA 11	BA	PPA
PA cond	PA 12	BA	PPA
PPA cond	PPA	PA 6/12	PPA
PPA cond	PPA	PA 6/12	PE
PPA cond	PPA	PA 6/12	PP
PPA cond	PPA	PA 6/12	PA 6
PPA cond	PPA	PA 6/12	PA 11
PPA cond	PPA	PA 6/12	PA 12
PPA cond	PE	PA 6/12	PPA
PPA cond	PP	PA 6/12	PPA
PPA cond	PA 6	PA 6/12	PPA
PPA cond	PA 11	PA 6/12	PPA
PA cond	PA 12	PA 6/12	PPA
PPA cond	PE	PPA	PE
PPA cond	PP	PPA	PP
PPA cond	PA 6	PPA	PA 6
PPA cond	PA 11	PPA	PA 11

	PA cond	PA 12	PPA	PA 12
	PPA cond	PE	PPA	PP
	PPA cond	PE	PPA	PA 6
	PPA cond	PE	PPA	PA 11
	PPA cond	PE	PPA	PA 12
	PPA cond	PP	PPA	PE
	PA cond	PA 6	PPA	PE
	PA cond	PA 11	PPA	PE
	PA cond	PA 12	PPA	PE
	PPA cond	PP	PPA	PA 6
	PPA cond	PP	PPA	PA 11
	PPA cond	PP	PPA	PA 12
	PA cond	PA 6	PPA	PP
	PA cond	PA 11	PPA	PP
	PA cond	PA 12	PPA	PP
	PA cond	PA 6	PPA	PA 11
	PA cond	PA 6	PPA	PA 12
	PA cond	PA 11	PPA	PA 6
	PA cond	PA 12	PPA	PA 6
	PA cond	PA 11	PPA	PA 12
	PA cond	PA 12	PPA	PA 11
PPA cond	PE	BA	PPA	PE
PPA cond	PP	BA	PPA	PP
PPA cond	PA 6	BA	PPA	PA 6
PPA cond	PA 11	BA	PPA	PA 11
PA cond	PA 12	BA	PPA	PA 12
PPA cond	PE	PA 6/12	PPA	PE
PPA cond	PP	PA 6/12	PPA	PP
PPA cond	PA 6	PA 6/12	PPA	PA 6
PPA cond	PA 11	PA 6/12	PPA	PA 11
PA cond	PA 12	PA 6/12	PPA	PA 12
PPA cond	PE	PPA	BA	PE
PPA cond	PP	PPA	BA	PP
PPA cond	PA 6	PPA	BA	PA 6
PPA cond	PA 11	PPA	BA	PA 11

PA cond	PA 12	PPA	BA	PA 12
PPA cond	PE	PPA	PA 6/12	PE
PPA cond	PP	PPA	PA 6/12	PP
PPA cond	PA 6	PPA	PA 6/12	PA 6
PPA cond	PA 11	PPA	PA 6/12	PA 11
PA cond	PA 12	PPA	PA 6/12	PA 12
PPA cond	PPA	PE	BA	PPA
PPA cond	PPA	PE	BA	PE
PPA cond	PPA	PP	BA	PP
PPA cond	PPA	PA 6	BA	PA 6
PPA cond	PPA	PA 11	BA	PA 11
PPA cond	PPA	PA 12	BA	PA 12
PPA cond	PPA	PE	PA 6/12	PPA
PPA cond	PPA	PE	PA 6/12	PE
PPA cond	PPA	PP	PA 6/12	PP
PPA cond	PPA	PA 6	PA 6/12	PA 6
PPA cond	PPA	PA 11	PA 6/12	PA 11
PPA cond	PPA	PA 12	PA 6/12	PA 12
PPA cond	PPA	BA	PA 6/12	PPA
PPA cond	PPA	BA	PA 6/12	PE
PPA cond	PPA	BA	PA 6/12	PP
PPA cond	PPA	BA	PA 6/12	PA 6
PPA cond	PPA	BA	PA 6/12	PA 11
PPA cond	PPA	BA	PA 6/12	PA 12
PPA cond	PE	BA	PA 6/12	PPA
PPA cond	PP	BA	PA 6/12	PPA
PPA cond	PA 6	BA	PA 6/12	PPA
PPA cond	PA 11	BA	PA 6/12	PPA
PA cond	PA 12	BA	PA 6/12	PPA
PPA cond	PPA	PA 6	PA 6/12	PPA
PPA cond	PPA	PA 6	PA 6/12	PE
PPA cond	PPA	PA 6	PA 6/12	PP
PPA cond	PPA	PA 6	PA 6/12	PA 6
PPA cond	PPA	PA 6	PA 6/12	PA 11
PPA cond	PPA	PA 6	PA 6/12	PA 12

PPA cond	PPA	PA 11	PA 6/12	BA	PPA
PPA cond	PPA	PA 11	PA 6/12	BA	PE
PPA cond	PPA	PA 11	PA 6/12	BA	PP
PPA cond	PPA	PA 11	PA 6/12	BA	PA 6
PPA cond	PPA	PA 11	PA 6/12	BA	PA 11
PPA cond	PPA	PA 11	PA 6/12	BA	PA 12
PPA cond	PPA	PA 12	PA 6/12	BA	PPA
PPA cond	PPA	PA 12	PA 6/12	BA	PE
PPA cond	PPA	PA 12	PA 6/12	BA	PP
PPA cond	PPA	PA 12	PA 6/12	BA	PA 6
PPA cond	PPA	PA 12	PA 6/12	BA	PA 11
PPA cond	PPA	PA 12	PA 6/12	BA	PA 12
PPA cond	PA 6	PPA	PA 6/12	BA	PE
PPA cond	PA 6	PPA	PA 6/12	BA	PP
PPA cond	PA 6	PPA	PA 6/12	BA	PA 6
PPA cond	PA 6	PPA	PA 6/12	BA	PA 11
PPA cond	PA 6	PPA	PA 6/12	BA	PA 12
PPA cond	PA 11	PPA	PA 6/12	BA	PE
PPA cond	PA 11	PPA	PA 6/12	BA	PP
PPA cond	PA 11	PPA	PA 6/12	BA	PA 6
PPA cond	PA 11	PPA	PA 6/12	BA	PA 11
PPA cond	PA 11	PPA	PA 6/12	BA	PA 12
PA cond	PA 12	PPA	PA 6/12	BA	PE
PA cond	PA 12	PPA	PA 6/12	BA	PP
PA cond	PA 12	PPA	PA 6/12	BA	PA 6
PA cond	PA 12	PPA	PA 6/12	BA	PA 11
PA cond	PA 12	PPA	PA 6/12	BA	PA 12
PA cond	PA 6	PA 6/12	PPA	BA	PE
PA cond	PA 6	PA 6/12	PPA	BA	PP
PA cond	PA 6	PA 6/12	PPA	BA	PA 6
PA cond	PA 6	PA 6/12	PPA	BA	PA 11
PA cond	PA 6	PA 6/12	PPA	BA	PA 12
PA cond	PA 11	PA 6/12	PPA	BA	PE
PA cond	PA 11	PA 6/12	PPA	BA	PP
PA cond	PA 11	PA 6/12	PPA	BA	PA 6

PA cond	PA 11	PA 6/12	PPA	BA	PA 11
PA cond	PA 11	PA 6/12	PPA	BA	PA 12
PA cond	PA 12	PA 6/12	PPA	BA	PE
PA cond	PA 12	PA 6/12	PPA	BA	PP
PA cond	PA 12	PA 6/12	PPA	BA	PA 6
PA cond	PA 12	PA 6/12	PPA	BA	PA 11
PA cond	PA 12	PA 6/12	PPA	BA	PA 12
PA cond	PA 6	PA 6/12	PE	BA	PPA
PA cond	PA 6	PA 6/12	PP	BA	PPA
PA cond	PA 6	PA 6/12	PA 6	BA	PPA
PA cond	PA 6	PA 6/12	PA 11	BA	PPA
PA cond	PA 6	PA 6/12	PA 12	BA	PPA
PA cond	PA 11	PA 6/12	PE	BA	PPA
PA cond	PA 11	PA 6/12	PP	BA	PPA
PA cond	PA 11	PA 6/12	PA 6	BA	PPA
PA cond	PA 11	PA 6/12	PA 11	BA	PPA
PA cond	PA 11	PA 6/12	PA 12	BA	PPA
PA cond	PA 12	PA 6/12	PE	BA	PPA
PA cond	PA 12	PA 6/12	PP	BA	PPA
PA cond	PA 12	PA 6/12	PA 6	BA	PPA
PA cond	PA 12	PA 6/12	PA 11	BA	PPA
PA cond	PA 12	PA 6/12	PA 12	BA	PPA

Patent Claims

- 5 1. Multilayer tube suitable for use in vehicles, containing at least one Polyphthalamide layer.
2. Multilayer tube as per claim 1 consisting of at least three layers, wherein the Polyphthalamide layer is a barrier layer.
- 10 3. Multilayer tube as per claim 1 or 2, wherein the outer and / or inner layer consist(s) of Polyphthalamide.
4. Multilayer tube as per claim 1 to 3, comprising at least one layer of Polyamide, preferably selected from the group 6,6-Polyamide, 11,11-Polyamide, 12,12-Polyamide, Copolymer from 6,6-Polyamide and 12,12-Polyamide.
- 15 5. Multilayer tube as per claim 1 to 4, wherein at least one Polyamide layer is a bonding agent.
6. Multilayer tube as per claim 1 to 5, containing at least one layer of Polyethlyene or Polypropylene or a Copolymer thereof.
- 20 7. Multilayer tube as per one of the claims 1 to 6, containing at least one layer of an adhesive or bonding agent.
8. Multilayer tube as per one of the claims 1 to 7, wherein at least one Polyphthalamide-layer or Polyamide-layer is
25 conductive.
9. Multilayer tube as per one of the claims 1 to 8, containing additions of softeners, flame restraints, anti-oxidation means or stabilizing agents.
- 30 10. Multilayer tube as per one of the claims 1 to 9, selected from the group

PPA - PA 6 - PA 6/12 (bonding agent) - PA 12,
PPA - PA 6 - PA 6/12 (bonding agent) - PPA,
PPA - PA 6/12 (bonding agent) - PA 12,
PA 6 - PPA - PA 6,
5 PA 12 - PPA - PA 12,
PPA - PA 6 (bonding agent) - PPA,
PPA cond. - PPA - PA 6 (bonding agent) - PPA.

11. Multilayer tube as per one of the claims 1 to 10,
characterized in that the hydrocarbon-permission level
10 is equal or below $0,5 \text{ g/m}^2$ for a time frame of 24 h (1
d).
12. Multilayer tube as per one of the claims 1 to 11,
wherein the tube comprises an outer cover.
13. Use of a multilayer tube as per one of the claims 1 to
15 12, as fuel and vapor tube.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/010059

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B27/34 F16L11/04 F16L9/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 195 244 A (TOKAI RUBBER IND LTD) 10 April 2002 (2002-04-10) claim 1 paragraph '0001! paragraph '0016! figures 1,2	1-3,13
X	US 2003/124281 A1 (MONSHEIMER SYLVIA ET AL) 3 July 2003 (2003-07-03) claims 1,6,8,10,13,14 paragraph '0038!	1,8,13
X	FR 2 766 548 A (HUTCHINSON) 29 January 1999 (1999-01-29) claim 1	1-3,13
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

15 November 2004

Date of mailing of the international search report

22/11/2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/010059

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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P,X	US 2003/192612 A1 (MILHAS PIERRE) 16 October 2003 (2003-10-16) claim 1 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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